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Renesas Starter Kit for R8C/27

User's Manual

RENESAS 16-BIT SINGLE-CHIP MICROCOMPUTER

M16C FAMILY / R8C/Tiny SERIES

Rev.3.00
Revision date: Aug.31,2007

Renesas Solutions Corp.
www.renesas.com

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Chapter 1. Preface

Cautions

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Glossary

ADC	Analog Digital Converter	LCD	Liquid Crystal Display
CPU	Central Processing Unit	LED	Light Emitting Diode
DAC	Digital Analog Converter	LIN	Local Interconnect Network
E8a	E8a On-chip debugger module	LSI	Large Scale Integration
IRQ	Interrupt ReQuest		

Chapter 2. Purpose

This Renesas Starter Kit is an evaluation tool for Renesas microcontrollers.

Features include:

- Renesas Microcontroller Programming.
- User Code Debugging.
- User Circuitry such as Switches, LEDs and potentiometer(s).
- User or Example Application.
- Sample peripheral device initialisation code.

The Renesas Starter Kit board contains all the circuitry required for microcontroller operation.

NOTE: This manual describes the technical details of the Renesas Starter Kit for R8C/27 hardware. The Quick Start Guide and Tutorial Manual provide details of the software installation and debugging environment.

Chapter 3. Power Supply

3.1. Requirements

This Renesas Starter Kit operates from a 3V to 5V power supply.

A diode provides reverse polarity protection only if a current limiting power supply is used.

All Renesas Starter Kit boards are supplied with an E8a debugger. This product is able to power the Renesas Starter Kit board with up to 300mA. When the Renesas Starter Kit is connected to another system then that system should supply power to the Renesas Starter Kit.

All Renesas Starter Kit boards have an optional centre positive supply connector using a 2.1mm barrel power jack.

Warning

The Renesas Starter Kit is neither under nor over voltage protected. Use a centre positive supply for this board.

3.2. Power – Up Behaviour

When the Renesas Starter Kit is purchased the Renesas Starter Kit board has the ‘Release’ or stand alone code from the example tutorial code pre-programmed into the Renesas microcontroller. On powering up the board the user LEDs will start to flash. After 200 flashes, or after pressing a switch the LEDs will flash at a rate controlled by the potentiometer.

Chapter 4. Board Layout

4.1. Component Layout

The following diagram shows the top layer component layout of the board.

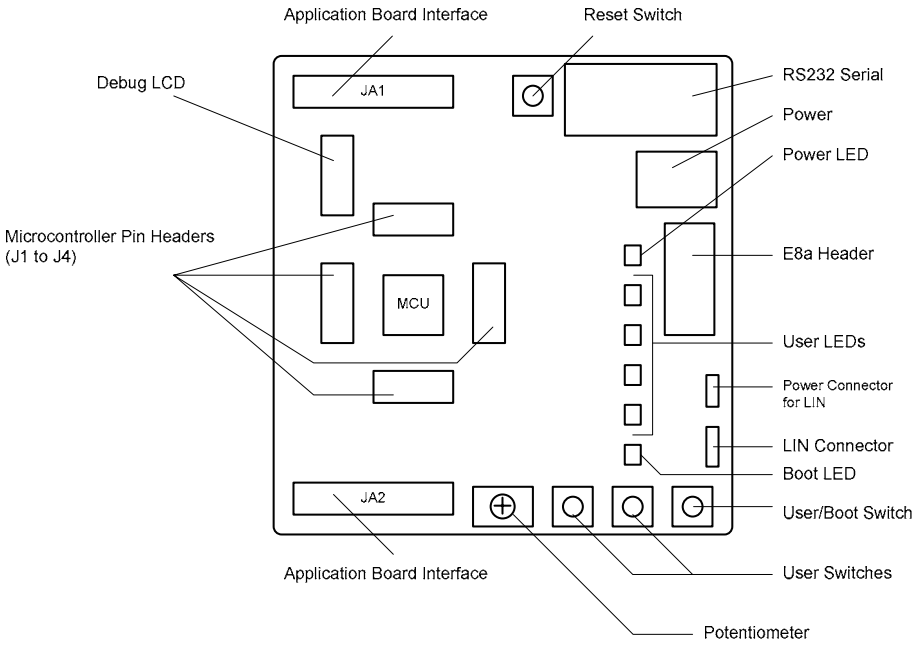

Figure 4-1: Board Layout

4.2. Board Dimensions

The following diagram gives the board dimensions and connector positions. All through hole connectors are on a common 0.1” grid for easy interfacing.

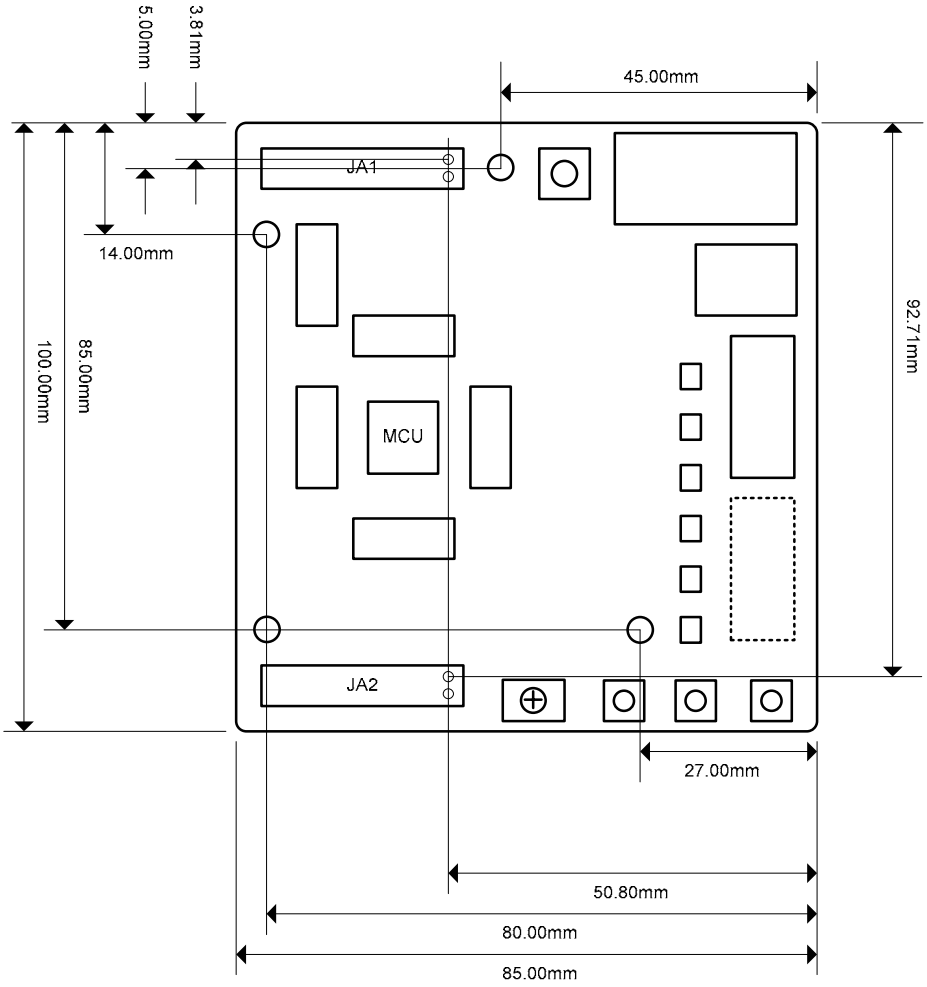

Figure 4-2 : Board Dimensions

Chapter 5. Block Diagram

Figure 5-1 is representative of the CPU board components and their connectivity.

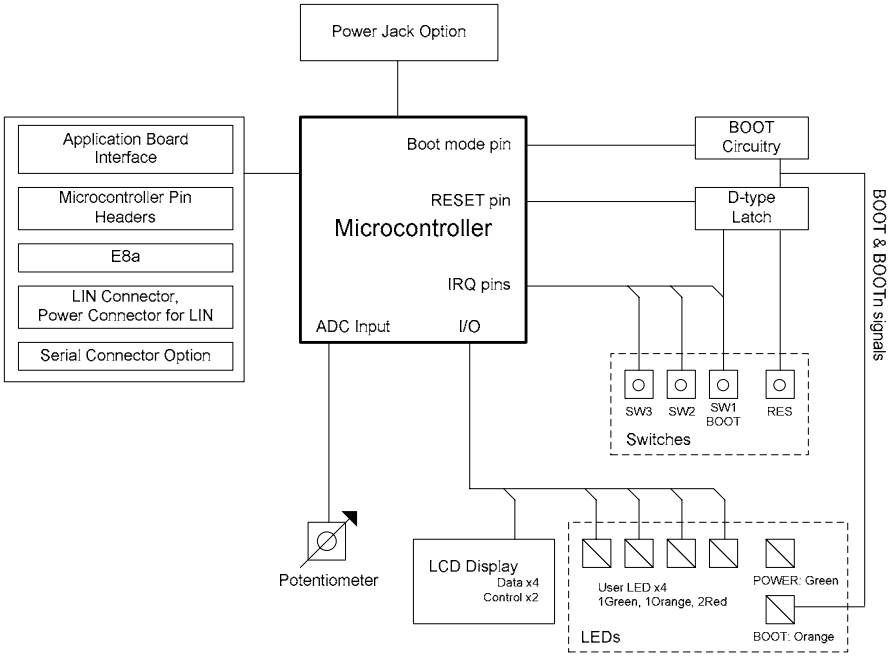

Figure 5-1: Block Diagram

Figure 5-2 is representative of the connections required to the Renesas Starter Kit.

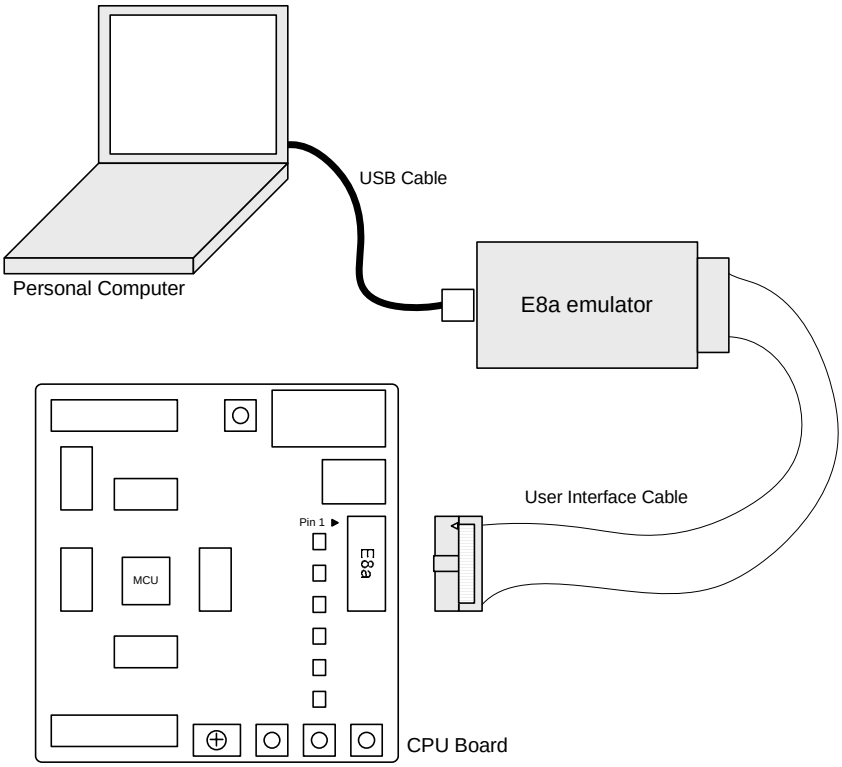

Figure 5-2 : Renesas Starter Kit Connections

Chapter 6. User Circuitry

6.1. Switches

There are four switches located on the board. The function of each switch and its connection are shown in Table 6-1.

Switch	Function	Microcontroller
RES	When pressed, the board microcontroller is reset.	RESET Pin3
SW1/BOOT*	Connects to an IRQ input for user controls. The switch is also used in conjunction with the RES switch to place the device in BOOT mode when not using the E8a debugger.	INT1 Pin10 (Port 1, pin 7)
SW2*	Connects to an IRQ Interrupt input for user controls.	INT3 Pin23 (Port 3, pin 3)
SW3*	Connects to a Key In Interrupt input for user controls	KI0 Pin22 (Port 1, pin 0)

Table 6-1: Switch Functions

*Refer to schematic for detailed connectivity information.

6.2. LEDs

There are six LEDs on the CPU board. The green 'POWER' LED lights when the board is powered. The orange 'BOOT' LED indicates the device is in BOOT mode when lit. The four user LEDs are connected to an IO port and will light when their corresponding port pin is set low.

Table 6-2, below, shows the LED pin references and their corresponding microcontroller port pin connections.

LED Reference (As shown on silkscreen)	Colour	Microcontroller Port Pin function	Microcontroller Pin Number
LED0	Green	Port 0.0	32
LED1	Orange	Port 0.1	31
LED2	Red	Port 0.2	30
LED3	Red	Port 0.3	29

Table 6-2: LED Port

6.3. Potentiometer

A single turn potentiometer is connected to AN11 (P1.3) of the microcontroller. This may be used to vary the input analog voltage value to this pin between VREF and Ground.

6.4. Serial port

The microcontroller programming serial port 1 is connected to the RS232 transceiver. This serial port can optionally be connected to the RS232 transceiver as well by fitting option resistors. The connections to be fitted are listed in the Table 6-3.

Description	Function	Fit for RS232
TxD1	Programming Serial Port	R43
RxD1	Programming Serial Port	R44

Table 6-3: Serial Port settings

A Secondary serial port is connected to the application headers. This is shared with the LIN module.

6.5. LCD Module

A LCD module is supplied to be connected to the connector J8. This should be fitted so that the LCD module lies over J1. Care should be taken to ensure the pins are inserted correctly into J8.The LCD module uses a 4 bit interface to reduce the pin allocation. No contrast control is provided; this is set by a resistor on the supplied display module. The module supplied with the Renesas Starter Kit only supports 5V operation.

Table 6-4 shows the pin allocation and signal names used on this connector.

J8					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	Ground	-	2	5V Only	-
3	No Connection	-	4	LCD_RS	14
5	R/W (Wired to Write only)	-	6	LCD_E	13
7	No Connection	-	8	No Connection	-
9	No Connection	-	10	No Connection	-
11	LCD_D4	28	12	LCD_D5	27
13	LCD_D6	26	14	LCD_D7	25

Table 6-4: LCD Module Connections

6.6. Option Links

Table 6-5 below describes the function of the option links associated with Power configuration. The default configuration is indicated by BOLD text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R16	Power Supply	**Connects J5 to Board_VCC**	J5 disconnected from Board_VCC	R18
R18	Power Supply	**Connects Board_VCC to board voltage line**	Board_VCC disconnected from board voltage line	R16, R17, R19, R20, R21
R19	Power Supply (External 5V)	**Connects CON_5V (external 5V) to Board_VCC**	CON_5V disconnected from Board_VCC	R18, R20, R21
R20	Power Supply (External 3.3V)	Connects CON_3V3 (external 3.3V) to Board_VCC	**CON_3V3 disconnected from Board_VCC**	R18, R19, R21
R21	MCU Power Supply	**Supply to MCU**	Fit Low ohm resister to measure current	R18, R19, R20
R28	User I/O Power Supply	**Connects Board_VCC to SW2, 3 and LED0-3**	Board_VCC disconnected from SW2, 3 and LED0-3	

Table 6-5: Power Configuration Links

Table 6-6 below describes the function of the option links associated with Clock configuration. The default configuration is indicated by BOLD text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R8	Oscillator	Connects external clock to MCU	**Connects X1 or X2 to MCU**	R10, R11, R12, R13, R14
R10	Oscillator	Connects external clock to MCU	**Connects X1 or X2 to MCU**	R8, R11, R12, R13, R14
R11	Oscillator (Sub clock)	Connects X2 to MCU	**Connects X1 or external clock to MCU**	R8, R10, R12, R13, R14, R15
R12	Oscillator (Sub clock)	Connects X2 to MCU	**Connects X1 or external clock to MCU**	R8, R10, R11, R13, R14, R15
R13	Oscillator (Main clock)	**Connects X1 to MCU**	Connects X2 or external clock to MCU	R8, R10, R11, R12, R14
R14	Oscillator (Main clock)	**Connects X1 to MCU**	Connects X2 or external clock to MCU	R8, R10, R11, R12, R13
R15	Oscillator (Sub clock)	Parallel resistor for sub clock (X2)	**Not fitted**	R11, R12

Table 6-6: Clock Configuration Links

Table 6-7 below describes the function of the option links associated with Serial configuration. The default configuration is indicated by BOLD text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R42	RS232 Serial	Disables RS232 Serial Transceiver	**Enables RS232 Serial Transceiver**	R43, R44
R43	Programming Serial Port	Connects RS232 port to Programming serial port	**Disconnected**	
R44	Programming Serial Port	Connects RS232 port to Programming serial port	**Disconnected**	

Table 6-7: Serial Configuration Links

Table 6-8 below describes the function of the option links associated with LIN configuration. The default configuration is indicated by BOLD text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R63	LIN	**For Master node setting**	For Slave node setting	R64, R65, R66
R64	LIN	**Connects LIN-NSLP to MCU port P1_6**	Disconnected	R63, R65, R66
R65	LIN	**Connects LIN-RXD0 to MCU port P1_5**	Disconnected	R63, R64, R66
R66	LIN	**Connects LIN-TXD0 to MCU port P1_4**	Disconnected	R63, R64, R65

Table 6-8: LIN Configuration Links

Table 6-9 below describes the function of the option links associated with Analog configuration. The default configuration is indicated by BOLD text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R6	ADC	**Connects CON_VREF (Reference voltage) to MCU**	CON_VREF disconnected from MCU	R17
R17	ADC	**Connects CON_VREF to Board_VCC**	CON_VREF disconnected from Board_VCC	R6

Table 6-9: Analog Configuration Links

Table 6-10 below describes the function of the option links associated with microcontroller pin function select configuration. The default configuration is indicated by **BOLD** text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R46	MCU Pin Function Select	**Connects AD3 to MCU port P0_4**	Disconnected	R47
R47	MCU Pin Function Select	Connects IO_4 to MCU port P0_4	**Disconnected**	R46
R48	MCU Pin Function Select	**Connects AD2 to MCU port P0_5**	Disconnected	R49
R49	MCU Pin Function Select	Connects IO_5 to MCU port P0_5	**Disconnected**	R48
R50	MCU Pin Function Select	**Connects IRQ1 to MCU port P1_7**	Disconnected	R29, R53
R53	MCU Pin Function Select	Connects TRIGb to MCU port P1_7	**Disconnected**	R29, R50
R55	MCU Pin Function Select	**Connects AD1 to MCU port P0_6**	Disconnected	R56
R56	MCU Pin Function Select	Connects IO_6 to MCU port P0_6	**Disconnected**	R55
R57	MCU Pin Function Select	**Connects AD0 to MCU port P0_7**	Disconnected	R58
R58	MCU Pin Function Select	Connects IO_7 to MCU port P0_7	**Disconnected**	R57
R59	MCU Pin Function Select	**Connects IRQ0 to MCU port P4_5**	Disconnected	R60
R60	MCU Pin Function Select	Connects TRIGa to MCU port P4_5	**Disconnected**	R59

Table 6-10: MCU Pin Function Select Configuration Links

Table 6-11 below describes the function of the option links associated with other options. The default configuration is indicated by **BOLD** text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R29	SW1	**Connects SW1 to MCU port P4_5**	Disconnected	R50, R53
R45	E8a	**Enables E8a Connection**	Do not fit the option resistor	
R54	LCD Module	**Connects LCD_E to MCU port P5_4**	Disconnected	

Table 6-11: Other Option Links

6.7.Oscillator Sources

Crystal oscillators are fitted on the board and used to supply the main/sub clock input to the Renesas microcontroller.

Table 6-12: Oscillator details the oscillators that are fitted and alternative footprints provided on this board:

Component		
Main clock (X1)	Fitted	20 MHz (HC/49U package)
Sub clock (X2)	Fitted	32.768 kHz (90SMX package)

Table 6-12: Oscillator

Main clock 'X1' is connected to microcontroller via the option resistors by the default.

6.8. Reset Circuit

The CPU Board includes a simple latch circuit that links the mode selection and reset circuit. This provides an easy method for swapping the device between Boot mode and Single chip mode. This circuit is not required on customers' boards as it is intended for providing easy evaluation of the operating modes of the device on the Renesas Starter Kit. Please refer to the hardware manual for more information on the requirements of the reset circuit.

The Reset circuit operates by latching the state of the boot switch on pressing the reset button. This control is subsequently used to modify the MODE pin states as required.

The MODE pin should change state only while the reset signal is active to avoid possible device damage.

The reset is held in the active state for a fixed period by a pair of resistors and a capacitor. Please check the reset requirements carefully to ensure the reset circuit on the customers' board meets all the reset timing requirements.

6.9. LIN Interface

This Renesas Starter Kit has hardware LIN interface. The interface is available on connector 'J10'. The connector 'J9' functions as power connector for LIN. The device can be operated either in Master node or Slave node. The device performs LIN communication in cooperation with Timer RA and UART0.

For more details on LIN interface please refer to R8C/26 Group, R8C/27 Group Hardware Manual.

Chapter 7. Modes

The Renesas Starter Kit supports Boot mode and Single chip mode.

Details of programming the FLASH memory is described in the R8C/26 Group, R8C/27 Group Hardware Manual.

7.1. Boot mode

The Boot mode settings for this Renesas Starter Kit are shown in Table 7-1: Boot Mode pin settings below:

MODE	LSI State after Reset End
Low	Boot Mode

Table 7-1: Boot Mode pin settings

The software supplied with this Renesas Starter Kit supports Boot mode using an E8a and High-performance Embedded Workshop only. However, hardware exists to enter boot mode manually, do not connect the E8a in this case. Press and hold the SW1/BOOT. The mode pin is held in its boot state while reset is pressed and released. Release the boot button. The BOOT LED will be illuminated to indicate that the microcontroller is in boot mode.

When neither the E8a is connected nor the board is placed in boot mode as above, the MODE pin is pulled high by a 4.7k resistor.

When an E8a is used the MODE pin is controlled by the E8a.

7.2. Single chip mode

Because the MODE pin is pulled high, this Renesas Starter Kit will always boot in Single chip mode when the E8a is not connected and the boot switch is not depressed. Refer to R8C/26 Group, R8C/27 Group Hardware Manual for details of Single chip mode.

MODE	LSI State after Reset End
High	Single chip Mode

Table 7-2: Single chip Mode pin settings

Chapter 8. Programming Methods

The board is intended for use with High-performance Embedded Workshop and the supplied E8a debugger. Refer to R8C/26 Group, R8C/27 Group Hardware Manual for details of programming the microcontroller without using these tools.

Chapter 9. Headers

9.1. Microcontroller Headers

Table 9-1 to Table 9-4 show the microcontroller pin headers and their corresponding microcontroller connections. The header pins connect directly to the microcontroller pins. * Marked pins are subject to option links.

J1					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	IIC_SCL	1	2	TMR1	2
3	RESn	3	4	CON_XOUT	4
5	Ground (VSS)	5	6	CON_XIN	6
7	UC_VCC	7	8	MODE_E8B	8

Table 9-1: J1

J2					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	IRQ0/TRIGa*	9	2	IRQ1/TRIGb*	10
3	TRISTn	11	4	MO_UD	12
5	MO_Wp	13	6	MO_Vp	14
7	SCIaCK	15	8	SCIaRX	16

Table 9-2: J2

J3					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	SCIaTX	17	2	AD_POT	18
3	MO_Up	19	4	P4_2/VREF	20
5	TMR0	21	6	IRQ3	22
7	IRQ2	23	8	IIC_SDA	24

Table 9-3: J3

J4					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	AD0/IO_7*	25	2	AD1/IO_6*	26
3	AD2/IO_5*	27	4	AD3/IO_4*	28
5	IO_3	29	6	IO_2	30
7	IO_1	31	8	IO_0	32

Table 9-4: J4

9.2. Application Headers

Table 9-5 and Table 9-6 below show the standard application header connections. * Marked pins are subject to option links.

JA1							
Pin	Header Name	Circuit Net Name	Device Pin	Pin	Header Name	Circuit Net Name	Device Pin
1	Regulated Supply 1	CON_5V	-	2	Regulated Supply 1	Ground	-
3	Regulated Supply 2	CON_3V3	-	4	Regulated Supply 2	Ground	-
5	Analogue Supply	NC	-	6	Analogue Supply	NC	-
7	Analogue Reference	CON_VREF	20	8	ADTRG	NC	-
9	ADC0	AD0*	25	10	ADC1	AD1*	26
11	ADC2	AD2*	27	12	ADC3	AD3*	28
13	DAC0	NC	-	14	DAC1	NC	-
15	IOPort0	IO_0	32	16	IOPort1	IO_1	31
17	IOPort2	IO_2	30	18	IOPort3	IO_3	29
19	IOPort4	IO_4*	28	20	IOPort5	IO_5*	27
21	IOPort6	IO_6*	26	22	IOPort7	IO_7*	25
23	IRQ3	IRQ3	22	24	I²C Bus (3rd pin)	NC	-
25	I²C Bus	IIC_SDA	24	26	I²C Bus	IIC_SCL	1

Table 9-5: JA1 Standard Generic Header

JA2							
Pin	Header Name	Circuit Net Name	Device Pin	Pin	Header Name	Circuit Net Name	Device Pin
1	Reset	RESn	3	2	External Clock Input	CON_XIN	6
3	Interrupt	NC	-	4	Regulated Supply 1	Ground	-
5	WDT overflow	NC	-	6	Serial Port	SCIaTX	17
7	Interrupt	IRQ0*	9	8	Serial Port	SCIaRX	16
9	Interrupt	IRQ1*	10	10	Serial Port	SCIaCK	15
11	Motor up/down	MO_UD	12	12	Serial Port Handshake	NC	-
13	Motor control	MO_Up	19	14	Motor control	NC	-
15	Motor control	MO_Vp	14	16	Motor control	NC	-
17	Motor control	MO_Wp	13	18	Motor control	NC	-
19	Timer Output	TMR0	21	20	Timer Output	TMR1	2
21	Timer Input	TRIGa*	9	22	Timer Input	TRIGb*	10
23	Interrupt	IRQ2	23	24	Tristate Control	TRISTn	11
25	SPARE	CON_XOUT	4	26	SPARE	AD_POT	18

Table 9-6: JA2 Standard Generic Header

Table 9-7 below show the LIN header connections.

J9		
Pin	Function	Signal Name
1	Power Supply (for LIN module)	VBAT
2	Ground	Ground
J10		
Pin	Function	Signal Name
1	Power Supply (for LIN module)	VBAT
2	LIN Bus Line	LIN
3	Ground	Ground

Table 9-7: LIN Headers

Chapter 10.Code Development

10.1. Overview

Note: For all code debugging using Renesas software tools, the Renesas Starter Kit board must be connected to a Personal Computer USB port via an E8a. An E8a is supplied with the Renesas Starter Kit product.

10.2. Mode Support

High-performance Embedded Workspace connects to the Microcontroller and programs it via the E8a. Mode support is handled transparently to the user.

10.3. Breakpoint Support

High-performance Embedded Workshop supports breakpoints on the user code, both in RAM and ROM.

Double clicking in the breakpoint column in the code sets the breakpoint. Breakpoints will remain unless they are double clicked to remove them.

10.4. Memory Map

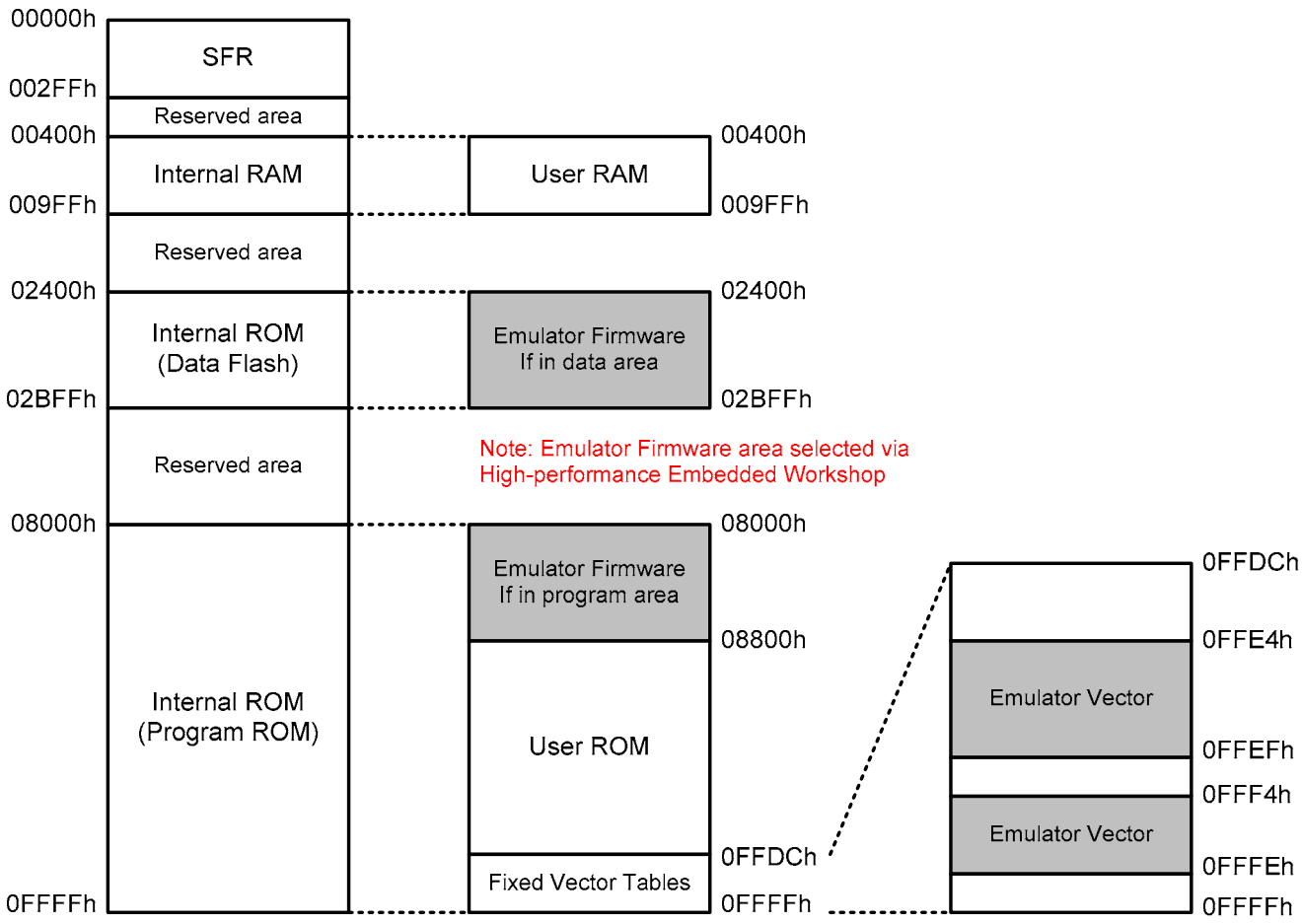

Figure 10-1 : Memory Map

Chapter 11. Component Placement

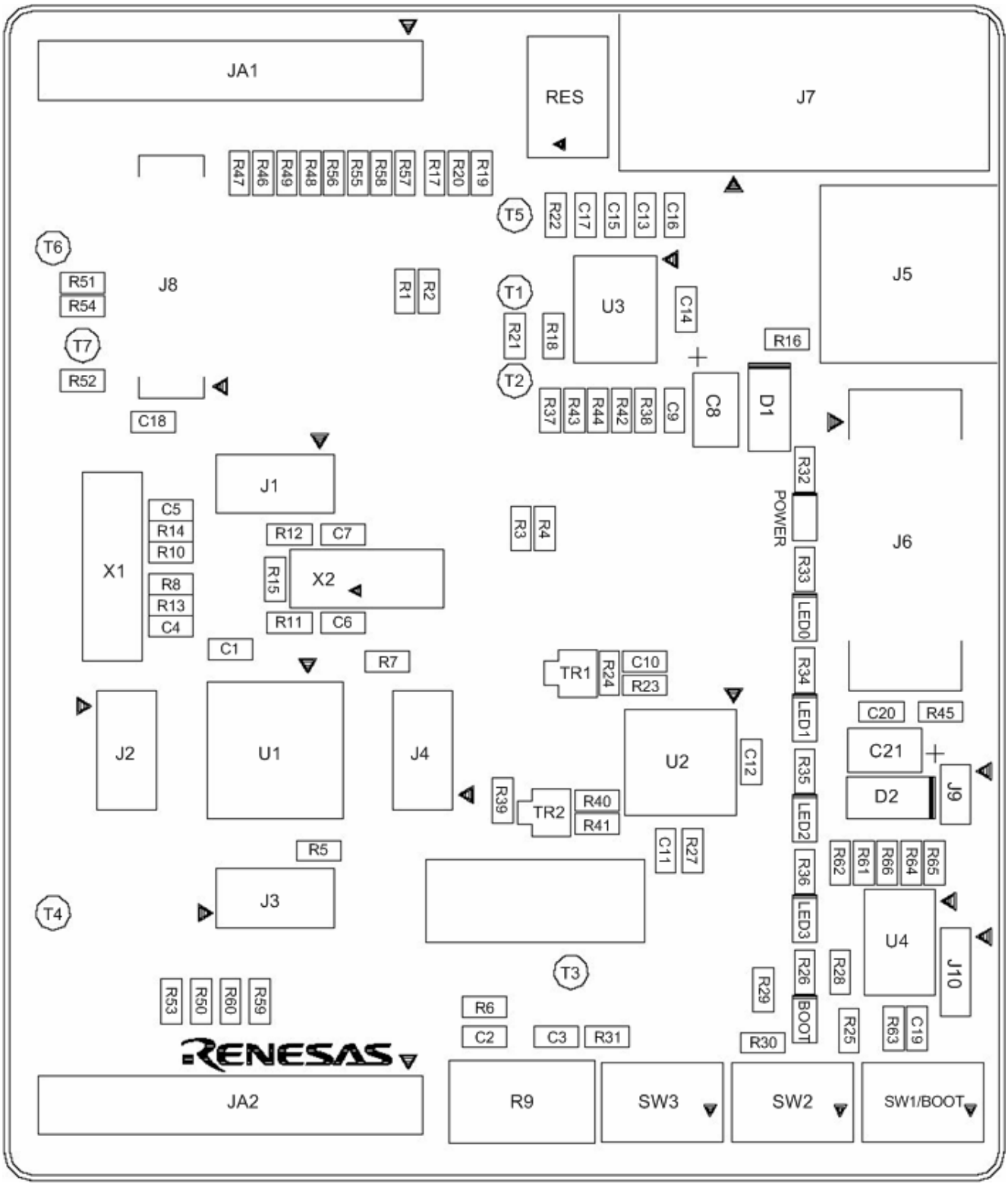

Figure 11-1 : Component Placement

Chapter 12. Additional Information

For details on how to use High-performance Embedded Workshop, refer to the High-performance Embedded Workshop manual available on the CD or from the web site.

For information about the R8C/27 group microcontrollers, refer to the R8C/26 Group, R8C/27 Group Hardware Manual.

For information about the R8C/27 assembly language, refer to the R8C/Tiny Series Software Programming Manual.
Online technical support and information is available at:

http://www.renesas.com/renesas_starter_kits

Technical Contact Details

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General information on Renesas Microcontrollers can be found on the Renesas website at:

http://www.renesas.com/.

Renesas Starter Kit for R8C/27
User's Manual
Publication Date Rev.3.00 Aug.31,2007
Published by: Renesas Solutions Corp.
4-1-6, Miyahara, Yodogawa-ku, Osaka City, 532-0003, Japan

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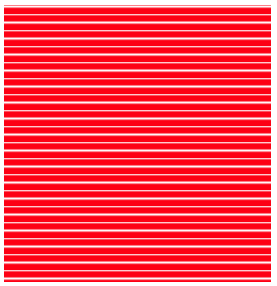

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